

Art as an Investment: Risk, Return and Comovements in Major Painting Markets

ANDREW C. WORTHINGTON^{1,*} & HELEN HIGGS¹

¹ School of Economics and Finance, Queensland University of Technology, Brisbane, Australia

Abstract. This paper examines the short and long-term price linkages among major art and equity markets over the period 1976-2001. The art markets examined are Contemporary Masters, French Impressionists, Modern European, 19th Century European, Old Masters, Surrealists, 20th Century English and Modern US paintings. A global equity index (with dividends and capitalisation changes) is also included. Multivariate cointegration procedures, Granger non-causality tests, level VAR and generalised variance decomposition analyses based on error-correction and vector autoregressive models are conducted to analyse short and long-run relationships among these markets. The results indicate that there is a stationary long-run relationship and significant short and long-run causal linkages between the various painting markets and between the equity market and painting markets. However, in terms of the percentage of variance explained most painting markets are relatively isolated, and other painting markets are generally more important than the equity market in explaining the variance that is not caused by innovations in the market itself. This suggests that opportunities for portfolio diversification in art works alone and in conjunction with equity markets exist, though in common with the literature in this area the study finds that the returns on paintings are much lower and the risks much higher than in conventional financial markets.

Keywords: Art and collectibles, portfolio diversification, market efficiency, risk and return.

1. Introduction

In March 1987 Vincent Van Gogh's [1853-1890] *Sunflowers* sold at auction for \$39.9 million (all dollar figures in USD), followed in November by the sale of *Irises* for \$53.9 million. Additional record-breaking sales in art markets followed closely. In May 1989, Pablo Picasso's [1881-1973] *Yo Picasso* sold for \$47.8 million, far exceeding the \$5.8 million that it last commanded in May 1981: his *Noces de Pierette* later sold for \$60.0 million. In May 1990, Van Gogh's *Portrait of Docteur Gachet* sold for \$82.5 million and Pierre-Auguste Renoir's [1841-1919] *At the Moulin de la Galette* for \$78.1 million, becoming the two most expensive pictures ever sold at auction (Pesando and Shum, 1999). Indeed, even demand for Modern and contemporary paintings in the 1980s was so strong that works by (often still-living) artists such as Roy Lichtenstein, Jackson Pollock, Jasper Johns, Robert Rauschenberg, Willem de Kooning and Andy Warhol were frequently attracting prices in excess of \$10 million (The Economist, 2000).

Obviously, these examples and others indicate that at least some paintings have increased significantly in value and thereby generated large rates of return for their owners. For instance, *Irises* had last been bought in 1948 for \$84,000 (some \$0.5 million at 1989 prices), such that the record 1987 sale provided a 12 percent real rate of return (de la Barre et al. 1994). And despite the well publicised bear market in art during the period 1989-1992, there has been a sustained revival in picture prices over much of the last decade, especially in areas outside the sky-high prices of Impressionist, Modern and contemporary works a decade earlier (Curry, 1998). For example, Old Master sale prices have been rising strongly now for

* Correspondence to: Dr. A.C. Worthington, School of Economics and Finance, Queensland University of Technology, GPO Box 2434, Brisbane QLD 4001, Australia. Tel. +61 (0)7 3864 2658, Fax. +61 (0)7 3864 1500, email. a.worthington@qut.edu.au.

five years, with many paintings selling for more than their high estimates (The Economist, 2000). A rediscovered El Greco [1541-1614] of *The Crucifixion* recently sold for more than six times its estimate at £3.6 million and a tiny flower painting by Ambrosius Bosschaert the Elder [1573-1621] realised five times expectations at £1.92 million.

In response to the commonly held belief that the art market yields huge profits in comparison to other more prosaic investment markets, a small but growing literature has examined the financial characteristics of the market in paintings, and art markets in general (paintings, sculpture, ceramics and prints, along with collectibles such as coins, stamps, antiques and furniture). This invariably accompanies a revival of interest in art investment by the business world [see, for example, Oleck and Dunkin (1999) and Peers and Jeffrey (1999)] Starting with the seminal work of Baumol (1986) much of this has been concerned with measuring the rate of return of paintings, however in recent years there has been an emerging emphasis on other analytical dimensions of art investment (Felton, 1998). In particular, the growing evidence of return predictability and cointegration in equity and bond markets has focused attention on the ability of auction series to provide meaningful forecasts of prices in art markets. This is especially important if the prices of art works can be taken as synthesising the effects of the artist, specificities of different media, reactions of art galleries, critics, museum directors, collectors and investors, etc. (Czujack et al., 1996). That is, the large variety of influences on art markets that normally defy parametrisation.

Similarly, there is the suggestion that the returns on works of individual artists and schools may owe much to their interrelationships with other artists within their school and indeed other schools via a certain degree of substitutability. Examination may then reveal common patterns or call attention to divergent behaviour. For example, for much of the last thirty years Impressionist, Modern and contemporary paintings have dominated international art markets. However, current trends indicate that Old Masters and Modern pictures are now returning to a longer-term equilibrium (The Economist, 2000). This highlights additional prospects for price forecasting in these markets. Finally, if art is to be regarded as a valid (albeit imperfect) addition to traditional investments in stocks, bonds and real estate amongst others, there is the added requirement of examining the prospects for diversification in such portfolios (Flores et al., 1998). It is also desirous to examine the prospects for diversification in portfolios composed primarily of art held by investors, collectors, dealers and museums, amongst others. If low correlations of returns exist between both individual artists and schools of art, diversifying across various categories of art and artists may allow investors to reduce portfolio risk while holding expected return constant.

Unfortunately, little empirical evidence exists concerning short and long-term price linkages among differing art markets and the concomitant prospects for portfolio diversification, both among art works alone and in combination with financial assets. The evidence that does exist is generally mixed. Ginsburgh and Jeanfils (1995) used vector autoregressive models to examine the pricing relationships between three schools of painters [Impressionist, Modern and Contemporary European Masters, Minor European Painters and Contemporary US Painters] in three different auction markets [New York, London and Paris/Versailles]. They found that while the various art markets move together, and in the short-run financial markets do influence the price of collectibles; there was no long-run relationship between these markets. Chanel (1995) used similar techniques and a sample of eighty-two well-known artists to establish the relationships between art markets and equity markets in New York, London, Paris and Tokyo. Chanel (1995) concluded that financial markets influence the art market, though with a lag of about one year. Czujack et al. (1996) also used cointegration

techniques, though with the prints of five individual artists and a global print index. The presumption was that the market for prints was much more liquid than that for original paintings. They concluded that the relationship of individual artists' prints to the global print index varied considerably from weakly endogenous to strongly exogenous. Accordingly, the purpose of the present paper is to add evidence to this nascent debate on comovements among art markets and between art and financial markets.

The paper itself is divided into five main areas. The second section briefly surveys the empirical literature concerning art as an investment. The third section explains the data employed in the present analysis, while the fourth section discusses the methodology employed. The results are dealt with in the fifth section. The paper ends with some brief concluding remarks.

2. Art as an Investment

It goes without saying that art markets differ substantially from financial markets. Art works are not very liquid assets, almost never divisible, transaction costs are high, and there are lengthy delays between the decision to sell and actual sale. Investing in art typically requires substantial knowledge of art and the art world, and a large amount of capital to acquire the work of well-known artists. The market is highly segmented and dominated by a few large auction houses, and risk is pervasive, deriving from both the physical risks of fire and theft and the possibility of reattribution to a different artist. And while auction prices represent, in part, a consensus opinion on the value of art works, values in turn are determined by a complex and subjective set of beliefs based on past, present and future prices, individual tastes and changing fashion.

In sharp contrast, most financial assets are almost always liquid, readily diversifiable and can be selected on the basis of a relatively small set of objective criteria. Such markets are characterised by a large number of buyers and sellers, transaction costs are low, and trades in perfectly or near identical assets are repeated millions of times daily in hundreds of competing markets and exchanges. Nevertheless, art has been traded on organised markets for some time, with the organisation of the global art market much the same as it was in the 17th century, and the place attributed to an artist by aesthetic judgement depends more or less upon the prices set in these markets (Gérard-Varet, 1995). While this implies that at least some tools of orthodox financial analysis can, and frequently have, been applied to art markets, there is also the necessity to clearly identify the distinguishing characteristics of these markets so that their findings can be examined in an appropriate context.

One major distinguishing feature of art markets is that the art objects themselves are created by individuals, and are for the most part produced as differentiated objects. Accordingly, and in principle, there is only one unique piece of original work: an extreme case of a heterogeneous commodity. However, heterogeneity does not mean singularity (Gerard-Varet, 1995). Some substitutability remains among the work of a single artist, or among the works of artists categorised within the same school. Nonetheless, as the creative outpouring of a single artist, or group of artists, their aggregate supply is nonaugmentable, comprised as it is of the works of deceased artists or outmoded or outdated schools.

These particular characteristics manifest themselves most abundantly in the risks associated with art investment. Attribution remains a perennial problem. An example is Peter Paul Rubens' [1577-1640] *Daniel in the Lion's Den*. Auctioned in 1882 for £1,680 by Christie's

London it was resold in 1885 for £2,520. However in 1963, having been attributed in the meantime to fellow Flemish Baroque Era painter Jacob Jordaens [1593-1678], it was auctioned for a mere £500, but in 1965, now acknowledged as a school piece by Rubens, it was acquired by the Metropolitan Museum of Art in New York for £178,600 (Frey and Pommerehne, 1989). There is a similar problem with fakes and forgeries. It has, for example, been claimed there are 8,000 paintings by the French Realist Camille Corot [1796-1875] in the United States alone: an astonishing number considering there are only 3,000 authenticated works by that master. A similar situation is thought to hold for works by Anthony van Dyck [1599-1641] and Maurice Utrillo [1883-1955] (Frey and Pommerehne, 1989).

Unfortunately, though the technical means of detecting fakes and forgeries has improved, transactions involving these works remain in the auction samples most often used to calculate the risk and return of art investment. Moreover, in addition to these financial risks arising from price uncertainty, there are purely material risks associated with the unique physical nature of art works. Paintings may be destroyed by fire, damaged during war, or stolen. The latter encompasses the sizeable problem of provenance for buyers, sellers and dealers in art. Of course, while many material risks can be insured against, insurance costs as a percentage of appraised value are relatively high (up to one percent per annum), and for the most part unknown. Similarly, substantial costs arise over time with maintenance and the restoration of art works, and these are seldom recognised in return calculations. It is also difficult to take into account the taxes due when transacting and holding an art object, though it is widely accepted that in many countries investment in art is a means of escaping or lowering the tax burden (Frey and Eichenberger, 1995a; 1995b). Regardless, a voluminous literature has arisen on calculating the returns on art investment. Starting with Baumol (1986), these include studies by Frey and Pommerehne (1989), Goetzmann (1993), Chanel et al. (1994), Candela and Scorcu (1997) and Pesando and Shum (1999). And for the most part “his [Baumol’s] results are here to stay: the (financial) rate of return on paintings is lower than for investment in financial assets (given higher risks in the former market) because paintings also yield a psychic return from owning and viewing the paintings” (Frey and Eichenberger, 1995b: 529).

Perhaps the main distinguishing feature between art markets and pure financial markets is that the expected return from art investment consists not only of price rises but also the aforementioned psychic return of art works: through their aesthetic qualities, possibly through their social characteristics, and in the case of pieces acquired by museums for their cultural significance, even public-good attributes. And without exception, and for obvious reasons, most studies of art investment have been unable to quantify these psychic returns associated with art as a consumption good and add them to the understated financial returns from art as an investment good. Recognising art as a consumption good goes far in explaining the segmentation that characterises most art markets, and in part accounts for the presence of behavioural anomalies less well-known in modern financial markets. Changing fashions and tastes also explain some of the extreme volatility in the prices of individual works of art. At the turn of the 20th century, Scottish industrialists were prepared to pay considerable sums for works by 19th century European artists like Josef Israëls [1824-1911] or Jacob Maris [1838-1899]. For example, in 1910 Maris’ *Entrance to the Zuiderzee* made £3,150 at auction, and £2,887 in 1924, but eight years later in 1932 it fetched no more than £75 (Fase, 1996). Frans Hals’ [1582-1666] *Man in Black* was auctioned in 1885 for a little more than £5 at Christie’s in London, and in 1913 reached £9,000 at Sotheby’s (Frey and Pommerehne, 1989). More recently, Picasso’s *La Lecture* was bought in (i.e. failed to sell) at \$4.8 million in May 1996 after having sold for \$6.3 million in May 1989.

To start with, the art market is characterised by a hierarchy of submarkets. In the primary market individual artists provide works to galleries, art exhibitions and directly to consumers. This market is generally characterised by a large number of sellers with a relatively small number of buyers interested in acquiring these assets (Gérard-Varet, 1995). Obviously, at any given point of time such opportunities are only available to living artists, and while conditions in the primary market for financial assets depend acutely on those established in the secondary market, in the most part art markets are devoid of such close relationships. In contrast, the secondary or dealer art market is substantially more concentrated and the probability of art works progressing from the primary market to a secondary market much lower. With few prospective buyers (both individual and institutional), large rewards can be expected for matching specialised art works to particular collectors. Here, the commercial reputation of galleries and dealers is inexorably mixed with the aesthetic reputation of artistic works, and the dealers themselves engage in a substantially monopolistically competitive market.

At the top of the hierarchy, there is an international market operated by relatively few auction houses [Sotheby's was founded in 1744, Christie's in 1762 (both London-based) and Paris-based Drouot in 1854] used by a restricted number of buyers (mostly individual wealthy collectors, public museums or 'private foundations'). In these markets, art sells only occasionally, and auction houses are the major players. Informational asymmetries are essential features of these markets and the auction houses, as the major dealers in the secondary market, make profits by having information about the willingness to pay of collectors interested by specific art works. Likewise, sellers are typically better informed about the qualities of their art object (i.e. its provenance) than buyers, though in some cases sellers may know equally little, especially if they did not originally purchase at auction and received the work through inheritance or gift. For example, WWII records indicate that the amount of art expropriated by Nazi Germany, which may or may not have been 'recaptured' by Allied soldiers and perhaps returned to its rightful owners, may be as much as 16 million individual objects. While some of this stolen art may be in the hands of persons knowledgeable in its value, this is by no means assured (Schwarz, 1991).

The dominating position of the major auction houses impacts upon the study of art investment markets in a number of ways. First, most analyses are based on auctions (since the data is reliable and easily available), though this may ignore sales which are quantitatively more important (i.e. dealers and galleries) and may exhibit different price movements. Moreover, auction prices should be interpreted as wholesale prices referring mainly to dealers: private collectors usually buy at higher and sell at lower prices to art dealing houses (Guerzoni, 1995). Accordingly, dealers (wholesalers) enjoy a systematically higher rate of return than is normally the case for collectors (retail investors) (Frey and Eichenberger, 1995a; 1995b). Second, transaction costs involved in sales through auction houses (fees, handling costs and insurance) vary significantly between countries, periods, auction houses, and individual transactions. Auction fees can range from 10 to 30 percent when both buying and selling art, and this considerably complicates analyses of rates of return.

Market segmentation, and the concomitant propensity for anomalies, is also likely to occur among art investors. Many private collectors are not profit orientated and are particularly prone to the anomalies that arise from 'endowment effects' (an art object is evaluated higher than one not owned), 'opportunity cost effects' (many collectors isolate themselves from considering the returns of alternative uses of funds) and a 'sunk cost effect' (past efforts to build a particular genre or school of art are important) (Frey and Eichenberger, 1995a;

1995b). Private collectors may also be subject to a 'bequest effect' whereby art objects given to their beneficiaries carry a psychic return over and above their notional value. These conditions are rarely found in modern financial markets.

At the least, it could be expected that corporate collectors undertake their investments concerned largely with financial returns. Rarely, however, is the means of collection open to more than a small number of personalities within a firm and even then is primarily used for consumption purposes. Lastly, public museums are important buyers of art. Once art works are acquired it is rare for these organisations to either be willing or able to dispose of works in the market, nor to change the speciality of their collection. Many specific art works are also obtained with hypothecated grants from governments or fundraising activities and these cannot usually be used for other purposes. Pommerehne (1994), for example, has argued that for these reasons sellers to museums systematically enjoy higher rates of return. Frey and Eichenberger (1995: 215) suggest *inter alia* that museums are also likely to be active in particular genres of art that do not attract individual or corporate collectors:

For instance, today religious pictures representing crucifixion or the torturing of saints, or which are offensive to other religions, paintings of bloody scenes or of dead game, or which are for some other reason 'politically incorrect', are out of fashion, and therefore in lower demand by individual collectors. The corresponding market, as far as it exists at all, is dominated by buyers who are little affected by such consideration, in particular by art museums which can argue they are only interested in the art historic aspects, or their traditional area of collection. Thus pure collectors tend to dominate such a market, and in equilibrium psychic benefits are high and financial returns low for such paintings.

Frey and Eichenberger (1995a; 1995b) later use this evidence to argue that the behavioural characteristics of art market participants vary dramatically between 'pure speculators', who's activity in art investment markets is largely associated with changes in financial risk, and 'pure collectors' who are more attune to the psychic returns of art and less-sensitive to notions of financial risk. In the extreme, the more 'pure collectors' there are in a market, the lower is the financial return in equilibrium; the major part of investment return is made up of psychic benefits. An emerging literature has examined these efficiency aspects of art markets, including studies by Coffman (1991), Louargand and McDaniel (1991), Pesando (1993) and Goetzmann (1993).

At first impression, art markets would appear to have little in common with pure financial markets. Most art markets would appear to be characterised by product heterogeneity illiquidity, market segmentation, information asymmetries, behavioural abnormalities, and almost monopolistic price setting. And there is no doubting the fact that a substantial component of the return from art investment is derived not from financial returns rather its intrinsic aesthetic qualities. However, in recent years it has been widely accepted that most art markets have moved closer to the ideals set by financial markets. Turnover, for example, has increased dramatically among the auction houses and the larger proportion of transactions are pursued in these as against traditional dealers. Information on alternative art investments is now more accessible through the attention of the media, and the publishing and dissemination of catalogues and price index series has increased the amount of information available to both buyers and sellers. Likewise, art markets are increasingly globalised and the widening of the asset pool to include collectibles, furniture, jewellery and wine, amongst others, has seen substantially greater participation in most art markets.

3. Data and Descriptive Statistics

The data employed in the study is composed of indices for eight major categories of paintings and one equity market index. All art index data is obtained from UK-based Art Market Research (AMR) and encompasses the period January 1976 to February 2001. AMR art indexes are used widely by a variety of leading institutions concerned with price movements in the arts, including Christie's, Sotheby's, the British Inland Revenue Service and the New York Federal Reserve, along with the *Financial Times*, *Wall Street Journal*, *The Economist*, *Business Week*, *The Art Newspaper* and *Handelsblatt* (AMR, 2001). All monthly index data is specified in US dollars. Selected descriptive statistics of the annualised returns for these eight art indexes and the equity index are presented in Table 1. The index series themselves are portrayed in Figure 1 and the monthly returns calculated using these indexes are depicted in Figure 2.

TABLE 1. *Selected descriptive statistics of annual art and global equity returns, 1976-2001*

	CM	FI	ME	NE	OM	SR	TE	US	EI
Mean	4.2090	3.7045	2.1398	2.4645	2.8132	2.0307	2.5541	3.3180	5.1736
Median	3.9766	6.0617	2.7789	1.3484	3.1091	3.0168	3.2300	1.5463	6.6307
Maximum	29.7088	34.2042	21.6283	17.0330	18.2180	22.6799	13.4611	26.4745	15.4727
Minimum	-15.2562	-40.5108	-23.7159	-16.0957	-8.1525	-29.3774	-12.1199	-27.4104	-7.8406
Standard deviation	10.5006	13.6610	11.2592	7.1423	7.5800	11.2977	7.6386	12.7691	5.8390
Coefficient of variation	2.4948	3.6876	5.2618	2.8981	2.6944	5.5636	2.9908	3.8485	1.1286
Skewness	0.4858	-0.9286	-0.4300	-0.0624	0.3586	-0.6922	-0.2471	-0.1118	-0.4650
Kurtosis	3.4723	5.9786	2.5919	3.5388	1.9856	3.8568	2.0100	2.8911	2.7842
Jarque-Bera	1.2643	13.3475	0.9818	0.3313	1.6718	2.8718	1.3265	0.0670	0.9872
JB <i>p</i> -value	0.5314	0.0013	0.6121	0.8473	0.4335	0.2379	0.5152	0.9670	0.6104

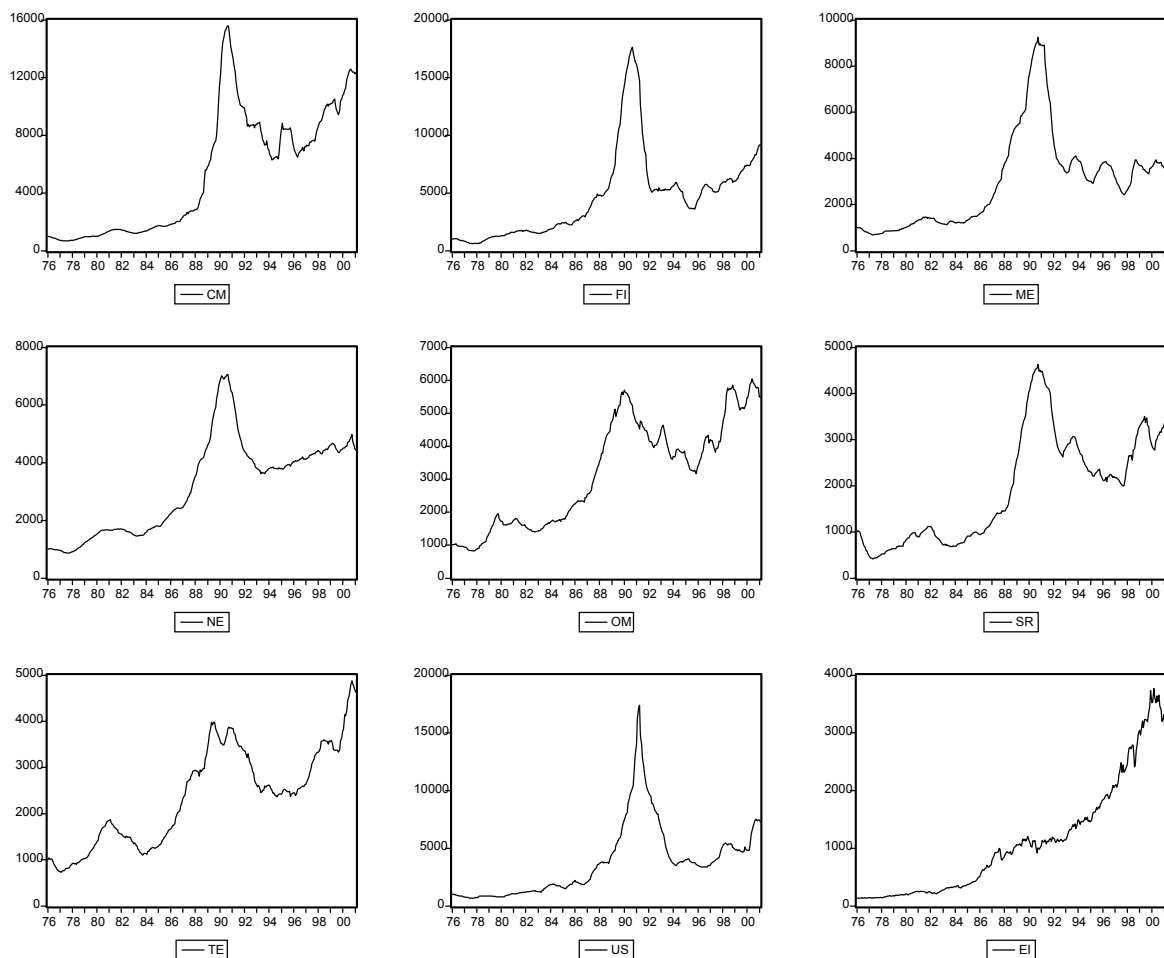
Notes: CM – Contemporary Masters, FI – French Impressionists, ME – Modern European, NE – 19th Century European, OM – Old Masters, SR – Surrealists, TE – 20th Century English, US – Modern US Paintings, EI – Global Equity.

The eight major art indexes are specified as follows: (i) Contemporary Masters (CM), covering 5,106 sales of current masters including Basquiat, Clemente and Polke; (ii) 20th Century English (TE) encompassing 10,603 sales by artists such as Dawson, Flint, Moore and Munnings; (iii) 19th Century European (NE) with 50,510 sales by artists including Maris, Troyon, Constable and Corot; (iv) French Impressionist (FI) with sales of 6,242 works by painters including Degas, Monet and Renoir; (v) Modern European (ME) with 17,538 sales by artists like Bonnard, Picasso and Utrillo; (vi) Modern US Paintings (US) with 10,607 sales of works by painters such as Kooning, Rivers and Warhol; (vii) Old Masters (OM) with 6,412 sales by artists including Gainsborough, Reynolds and Storck; and (viii) Surrealists (SR) with 10,395 sales by artists including Dali, Magritte and Picabia. The indexes selected are consistent with studies in the area of art investment returns and risk and represent some of the most closely followed painting sub-sectors. The global equity index (EI) used in the study is the Morgan Stanley Capital International (MSCI) World Equity Index (including dividend reinvestment and capitalisation changes). This index is calculated on the basis of a sample of 1600 companies listed on stock exchanges in the 22 developed markets that make up the MSCI National Indices (excluding Luxembourg).

In common with most work in this area, the figures in Table I show that the mean annual returns on the various painting markets are lower than those obtained in global equity markets, irrespective of risk. Over the period 1976 to 2001 annual returns on the global equity market (EI) averaged 5.18 percent, while the largest art returns were 4.21 percent for

Contemporary Masters (CM), 3.70 percent for French Impressionists (FI) and 3.32 percent for Modern US (US) paintings. And contrary to theoretical expectations, the risk (as measured by standard deviation) is much higher for art than equity markets. For example, the standard deviation of annual returns for the global equity index was only 5.84 percent, while the least risky art market (19th Century European) had a standard deviation of 7.14 percent and the most risky (French Impressionists) a standard deviation of 13.66 percent. These suggestions are further reinforced by the coefficients of variation (standard deviation divided by mean return) in Table 1. The global equity market has the lowest coefficient of variation of 1.13. Among the art markets themselves, three sub-groups are noticeable. Markets with a relatively high coefficient of variation (more risk per unit of return) include Modern European (ME) and the Surrealists (SR). French Impressionists (FI) and Modern US (US) have coefficients of variation of 3.68 and 3.84 respectively. Art markets with low coefficients of variation include Contemporary Masters (CM), 19th Century European (NE), Old Masters (OM) and 20th Century English (TE). The coefficients of variation for this last group of art markets range between 2.49 and 2.99. Some indication of the popularly acclaimed appeal of art markets as an investment vehicle can be gained from the maximum returns in Table 1 with annual returns ranging as high as 34.20 percent (French Impressionists) as compared to a maximum global equity return over the period of 15.48 percent.

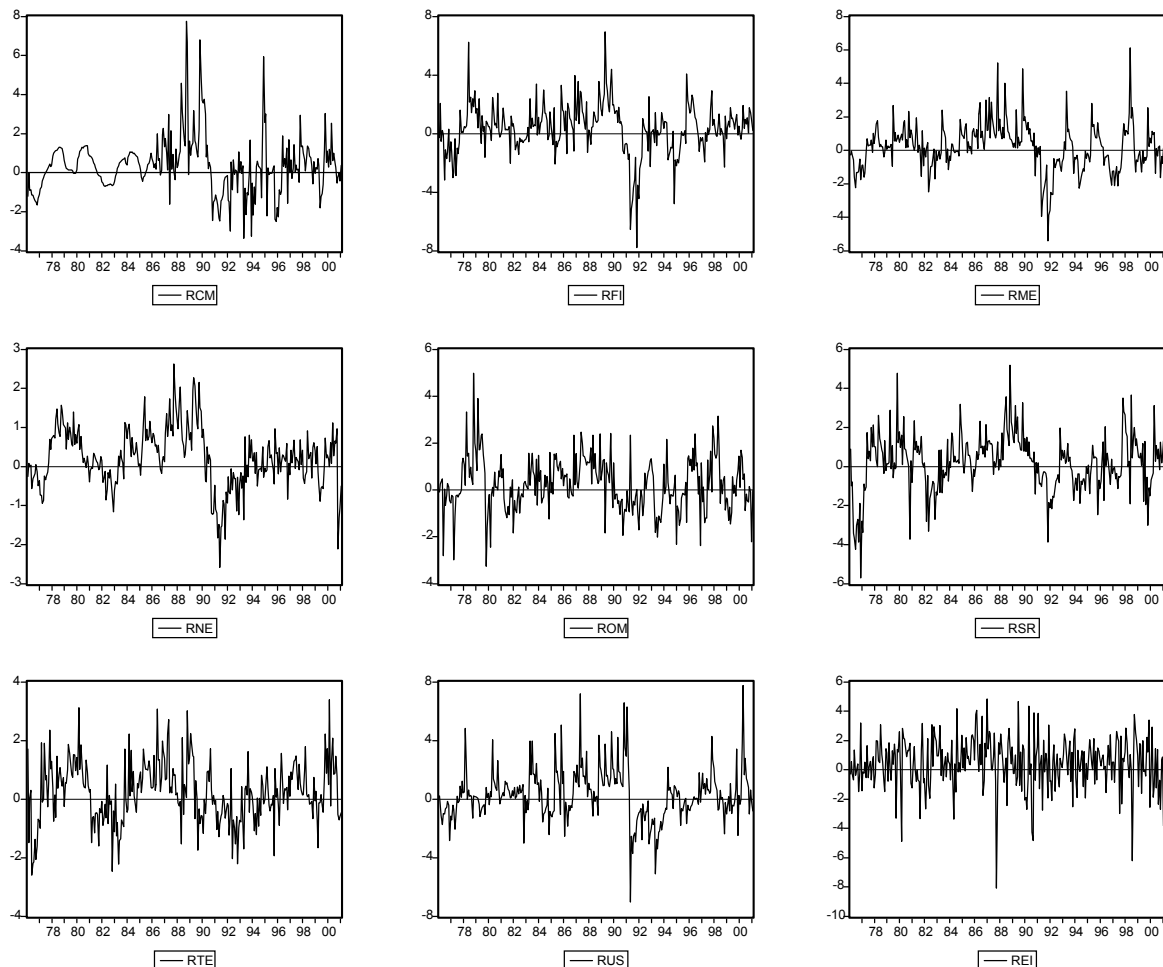
FIGURE 1. *Monthly art and equity index series, 1976-2001*



Notes: CM – Contemporary Masters, FI – French Impressionists, ME – Modern European, NE – 19th Century European, OM – Old Masters, SR – Surrealists, TE – 20th Century English, US – Modern US Paintings, EI – Global Equity.

The most noticeable feature of the art indices in Figure 1 is the dramatic bull market in paintings corresponding to the late 1980s and early 1990s. With the exception of Old Masters (OM) and 20th Century English (TE) paintings [whose markets have strengthened since 1995] the record highs set during 1990/91 have not been surpassed. Most of these markets peaked in September 1990 (CM, FI, NE), some peaked slightly later in October 1990 (ME and SR), while Modern US did not peak until April 1991. The record high for Old Masters was set in June 2000 and 20th Century English in October 2000, and the highest value for the global equity index was in March 2000.

FIGURE 2. *Monthly art and equity returns, 1976-2001*



Notes: CM – Contemporary Masters, FI – French Impressionists, ME – Modern European, NE – 19th Century European, OM – Old Masters, SR – Surrealists TE – 20th Century English, US – Modern US Paintings, EI – Global Equity.

The monthly returns associated with these indices are depicted in Figure 2. All of the art return series are clearly more volatile than the global equity returns, and most of the art markets have periods of sustained negative returns corresponding to the 1989-1992 bear market. Similarly, visual examination of the art returns indicates a strong cyclical pattern and this appears to be shared by most of the art markets in question. Returns are generally positive in the period 1977-1981, negative from 1982-1984, positive from 1985 to 1991, negative from 1992 to 1996, and positive thereafter. Of all the return series (including the global equity index) only in the case of the French Impressionists does the Jarque-Bera statistic (Table 1) reject the null hypothesis in favour of a normal distribution of returns.

3. Empirical Methodology

The paper investigates the comovements among art and equity markets as follows. To start with, since the variance of a nonstationary series is not constant over time, conventional asymptotic theory cannot be applied for those series. Unit root tests of the null hypothesis of nonstationarity are conducted in the form of an Augmented Dickey-Fuller (ADF) regression equation:

$$\Delta Y_{it} = \alpha_0 + \alpha_1 t + \rho_0 Y_{it-1} + \sum_{i=1}^p \rho_i \Delta Y_{it-i} + \varepsilon_{it} \quad (1)$$

where Y_{it} denotes the index for the i -th market at time t , $\Delta Y_{it} = Y_{it} - Y_{it-1}$, ρ are coefficients to be estimated, p is the number of lagged terms, t is the trend term, α_1 is the estimated coefficient for the trend, α_0 is the constant, and ε is white noise. The critical values in MacKinnon (1991) are used in order to determine the significance of the test statistic associated with ρ_0 . ADF tests are performed on both the levels and first differences of the indices. Where each index is nonstationary in levels and stationary in first differences, it may be concluded that the indices are individually integrated of order 1, $I(1)$. An important property of $I(1)$ variables is that there can be a linear combination of these variables that are $I(0)$ (stationary). If this is so, then these variables are cointegrated such that there is some tendency for the two series in the long run not to drift too far apart (or move together).

Following Engle and Granger (1987) suppose we have a set of m indices $y_t = [Y_{1t}, Y_{2t}, \dots, Y_{mt}]'$ such that all are $I(1)$ and $\beta' y_t = u_t$ is $I(0)$, then β is said to be a cointegrated vector and $\beta' y_t = u_t$ is called the cointegrating regression. The components of y_t are said to be cointegrated of order d, b denoted by $y_t \sim CI(d, b)$ where $d > b > 0$, if (i) each component of y_t is integrated of order d, b and (ii) there exists at least one vector $\beta = (\beta_1, \beta_2, \dots, \beta_m)$, such that the linear combination is integrated of $(d - b)$. By Granger's theorem, if the indices are cointegrated, they can be expressed in an Error Correction Model (ECM) encompassing the notion of a long-run equilibrium relationship and the introduction of past disequilibrium as explanatory variables in the dynamic behaviour of current variables. This model thus allows a test for both short-term and long-term relationships between the indices. The ECM is specified as follows:

$$\Delta y_t = \alpha_0 + \Pi y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

where, $\Pi = \alpha\beta'$, α and β are $m \times r$ matrices, r is the cointegrating rank, Γ_i is the coefficients of the lagged difference terms, and all other variables are as previously defined. In (2) the long-run relationship is captured by $\beta' y_t$, and the differenced terms and the terms that are adjusted by the long-run relationship (the summation term on the right-hand side) capture the short-run relationship.

In order to implement the ECM, the order of cointegration must be known. A useful statistical test for determining the cointegrating rank r is proposed by Johansen (1991) and Johansen and Juselius (1990). The test is based on the MLE and the rank of Π (denoted by r) is tested based on its eigenvalues. The trace test is proposed. In the trace test, the test statistic is:

$$\lambda(r) = -T \sum_{i=r+1}^m \ln(1 - \lambda_i) \quad (3)$$

where T is the number of useable observations, λ_i is the eigenvalues of $|\lambda S_{kk} - S_{k0} S_{00}^{-1} S_{k0}| = 0$ and $\hat{\Pi}$ is the estimator of the coefficient matrix of error correction terms. The test statistic (3) tests the null hypothesis of the number of distinct cointegrating vectors as $r = 0$ versus $r > 0$, $r \leq 1$ versus $r > 1$, and so on. For example, to test for no cointegrating relationship, r is set to zero and the null hypothesis is $H_0 : r = 0$ and the alternative is $H_1 : r > 0$.

One potential problem is that the Johansen (1991) test can be affected by the lag order in (2). The lag order is determined by using the likelihood ratio (LR) test. The optimum number of lags to be used in the VAR models is determined by the likelihood ratio (LR) test statistic:

$$LR = (T - K) \ln(|\Sigma_0|/|\Sigma_A|) \quad (4)$$

where T is the number of observations, K denotes the number of restrictions, Σ denotes the determinant of the covariance matrix of the error term, and subscripts 0 and A denote the restricted and unrestricted VAR, respectively. LR is asymptotically distributed χ^2 with degrees of freedom equal to the number of restrictions. The test statistic in (4) is used to test the null hypothesis of the number of lags being equal to $k - 1$ against the alternative hypotheses that $k = 2, 3, \dots$ and so on. The test procedure continues until the null hypothesis fails to be rejected, thereby indicating the optimal lag corresponds to the lag of the null hypothesis.

These cointegration tests examine long-term causality among the eight art markets and the global equity market. In order to examine the short-run relationships, Granger (1969) non-causality tests are specified. Essentially tests of the prediction ability of time series models, an index causes another index in the Granger sense if past values of the first index explain the second, but past values of the second index do not explain the first. If the indices in question are cointegrated, Granger non-causality is tested using the ECM:

$$\Delta y_t = \gamma_0 + \sum_{i=1}^r \psi_i \Theta_{t-1} + \sum_{i=1}^m \gamma_i \Delta y_{t-i} + \varepsilon_t \quad (5)$$

where Θ contains r individual error-correction terms, r is the number of long-term cointegrating vectors via the Johansen procedure, ψ and γ are parameters to be estimated, and all other variables are as previously defined. If there is no cointegrated relationship, the causality tests are conducted using the following VAR model:

$$\Delta y_t = \gamma_0 + \sum_{i=1}^m \gamma_i \Delta y_{t-i} + \varepsilon_t \quad (6)$$

In both cases, the causality test is based on an F -statistic that is calculated using the constrained and unconstrained form of each equation. If the hypothesis $\gamma_{jl} = 0 (j = 1, 2, \dots, m)$ fails to be rejected the j -th index does not Granger cause the l -th index, and current changes in l -th index cannot be explained by changes in the j -th index. If the hypothesis is rejected, the j -th index Granger-causes the l -th index and current changes

in the l -th index can be explained by past changes in the j -th index, thereby indicating a casual relationship.

One problem with a Granger non-causality test based on (5) is that it is affected by the specification of the model. ECM is estimated under the assumption of a certain number of lags and cointegrating equations, which means that the actual specification thereby depends on the pre-test unit root (ADF) and cointegration (Johansen) tests. To avoid possible pre-test bias, Toda and Yamamoto (1995) propose the level VAR procedure. Essentially, the level VAR procedure is based on VAR for the level of variables with the lag order p in the VAR equations given by $p=k+d_{max}$, where k is the true lag length and d_{max} is the possible maximum integration order of variables.

Therefore, the estimated VAR is expressed as:

$$y_t = \hat{\gamma}_0 + \hat{\gamma}_1 t + \Lambda + \hat{\gamma}_q t^q + \hat{J}_1 y_{t-1} + \Lambda + \hat{J}_k y_{t-k} + \Lambda + \hat{J}_p y_{t-p} + \hat{\varepsilon}_t, \quad (7)$$

where $t = 1, \dots, T$ is the trend term and $\hat{\gamma}_i, \hat{J}_j$ are parameters estimated by OLS. Note that d_{max} does not exceed the true lag length k . Equation (7) can be written as:

$$Y' = \hat{\Gamma}'\Lambda + \hat{\Phi}'X + \hat{\Psi}'Z' + \hat{E}' \quad (8)$$

where $\hat{\Gamma} = (\hat{\gamma}_0, K, \hat{\gamma}_q)$, $\Lambda = (\tau_1, K, \tau_q)$ with $\tau_t = (1, t, K, t^q)'$, $\hat{\Phi} = (\hat{J}_1, K, \hat{J}_k)$, $\hat{\Psi} = (\hat{J}_{k+1}, K, \hat{J}_p)$, $X = (x_1, \Lambda, x_T)$ with $x_t = (y'_{t-1}, K, y'_{t-k})'$, $Z = (z_1, \Lambda, z_T)$ with $z_t = (y'_{t-k-1}, K, y'_{t-p})'$ and $\hat{E}' = (\hat{\varepsilon}_1, K, \hat{\varepsilon}_T)$. As restrictions in parameters, the null hypothesis $H_0 : f(\phi) = 0$ where $\phi = \text{vec}(\Phi)$ is tested by a Wald statistic defined as:

$$W = f(\hat{\phi})' [F(\hat{\phi}) \{ \hat{\Sigma}_\varepsilon \otimes (X'QX)^{-1} \} F(\hat{\phi})']^{-1} f(\hat{\phi}) \quad (9)$$

where $F(\phi) = \partial f(\phi) / \partial \phi'$, $\hat{\Sigma}_\varepsilon = T^{-1} \hat{E}' \hat{E}$, $Q = \hat{Q}_\tau - \hat{Q}_\tau Z (Z' \hat{Q}_\tau Z)^{-1} Z' \hat{Q}_\tau$ and $\hat{Q}_\tau = I_T - \hat{\Lambda} (\hat{\Lambda}' \hat{\Lambda})^{-1} \hat{\Lambda}'$ where I_T is a $T \times T$ identity matrix. Under the null hypothesis, the Wald statistic (9) has an asymptotic chi-square distribution with m degrees of freedom that corresponds to the number of restrictions. Although Toda and Yamamoto (1995) present this method principally for the purpose of Granger non-causality testing, tests based on level VAR equations can also be used to examine long-run relationships. Test results based on the ECM can then be regarded as an indicator of short-run causality, while the causality tests by the level VAR can complement the result of the cointegration tests in terms of long-run information.

One final limitation of these tests is that while they indicate which markets Granger-cause another, they do not indicate whether yet other markets can influence a given market through other equations in the system. Likewise, Granger causality does not provide an indication of the dynamic properties of the system, nor does it allow the relative strength of the Granger-causal chain to be evaluated. However, decomposition of the variance of forecast errors of a given market allows the relative importance of other markets in causing fluctuations in that market to be ascertained. One likely problem is that the decomposition of variances is sensitive to both the assumed origin of the shock and to the order it is transmitted to other markets. That is, the results of the variance decomposition depend on the ordering of

variables. One approach to this problem is to randomly order the variables a number of times and compare the results. Unfortunately, random ordering of nine indexes is neither practical nor sufficient to clearly highlight any disparities. The most realistic ordering criterion under these circumstances is to order markets by their effect to other markets: that is, in descending order of the number of causes in the causality tests.

4. Empirical Results

Table 2 presents the ADF unit root tests (1) for the eight painting indices and the global equity index in price level and price-differenced forms. In all instances, the null hypothesis of nonstationarity is tested. Analysis of the price levels series indicates non-stationarity for all painting and equity markets. However, all of the ADF test statistics are significant in first differenced form at the .10 level, indicating stationarity and the suggestion that each index series is integrated of order 1 or I(1). The finding of non-stationarity in levels and stationarity in first differences provides comparable art market evidence to Chancel (1995), Ginsburgh and Jeanfils (1995) and Taylor (1995). However, it should be noted that all three of these studies used quarterly rather than monthly data.

<i>Augmented Dickey-Fuller (ADF) unit root tests</i>			
Market	Code	Level series	First differenced series
Contemporary Masters	CM	-2.5941	-4.9155***
French Impressionists	FI	-2.5638	-4.8539***
Modern European	ME	-2.1271	-4.2649***
19 th Century European	NE	-1.9306	-4.1228***
Old Masters	OM	-1.7545	-5.5394***
Surrealists	SR	-2.7438	-3.8669***
20 th Century English	TE	-1.7606	-4.9656***
Modern US Paintings	US	-2.3868	-4.5105***
Global Equity	EI	-1.9452	-2.8332*
1% critical value		-3.9930	-3.4546
5% critical value		-3.4266	-2.8716
10% critical value		-3.1363	-2.5721

Notes: Hypotheses H_0 : unit root, H_1 : no unit root (stationary). The lag orders in the ADF equations are determined by the significance of the coefficient for the lagged terms. Intercepts and trends are included in the levels series, intercepts only in the first-differenced series. Asterisks denote significance at: *** – .01 level, ** – .05 level and * – .10 level.

As discussed, Johansen cointegration trace tests are used to obtain the cointegrating rank. The likelihood ratio trace test statistics are detailed in Table 3. As multivariate cointegration tests, the results cover all the included markets simultaneously rather than simple bivariate combinations. They therefore consider the wide range of portfolio diversification options available to investors, as well as the scope of market interrelationships that may not be reflected in pairwise combinations. Also include in Table 3 are critical values at the .10 and .05 level. For the period in question, the trace test statistics are greater than the critical values at the .05 level for the null hypotheses of $r = 0$ to $r \leq 6$ thereby rejecting the null hypothesis. However, the null hypothesis of $r \leq 7$ fails to be rejected in favour of $r > 7$ thereby indicating a cointegrating rank of 7. The primary finding obtained from the Johansen cointegration tests is that a stationary long-run relationship exists between all the art and equity markets. That is, all nine series are cointegrated. Finding such cointegration among art markets and between art markets and the equity market is a nontrivial fact because it implies that, in the long run, the

prices for various markets do not diverge and also that their short-run variations are influenced by this long-run equilibrium. Nevertheless, while the cointegrating relationship found is over the entire sample period, there may well have been sub-periods when the various series did diverge.

TABLE 3. *Cointegration tests and eigenvalues*

H ₀	H ₁	Eigenvalue	Likelihood ratio	5 percent critical value	10 percent critical value
r = 0	r > 0	0.3152	354.2646	192.8900	204.9500
r ≤ 1	r > 1	0.1711	241.0357	156.0000	168.3600
r ≤ 2	r > 2	0.1654	184.9150	124.2400	133.5700
r ≤ 3	r > 3	0.1292	130.8410	94.1500	103.1800
r ≤ 4	r > 4	0.0975	89.4914	68.5200	76.0700
r ≤ 5	r > 5	0.0798	58.8222	47.2100	54.4600
r ≤ 6	r > 6	0.0749	33.9596	29.6800	35.6500
r ≤ 7	r > 7	0.0233	10.6752	15.4100	20.0400
r ≤ 8	r = 9	0.0120	3.6154	3.7600	6.6500
Accepted			7		

Notes: The optimal lag order of each VAR model was selected using likelihood ratio (LR) tests for the significance of the coefficient for maximum lags and Schwarz's Bayesian Information Criterion (BIC). In each cointegrating equation, the intercept (no trend) is included.

Since cointegration exists between the art and equity indices, Granger non-causality tests are performed on the basis of the ECM in (5). *F*-statistics are calculated to test the null hypothesis that the first index series does not Granger-cause the second, against the alternative hypothesis that the first index Granger-causes the second. Calculated statistics and *p*-values for the various markets are detailed in Table 4. Among the nine markets, twenty-eight significant causal links are found (at the 5 percent level or lower). For example, column 3 shows that the 19th Century European, Old Masters and Modern US painting markets and the equity market affect the Modern European painting market. Further insights are gained by examining the rows in Table 4 indicating the effects of a particular market on all markets. The Modern European market, for example, influences four art markets: Contemporary Masters, French Impressionists, 20th Century English and Modern US painting markets. The fact that the Modern US painting market is influenced by, and in turn influences, the market for Modern European paintings suggests that there is 'feedback' in these two art markets. There is also an indication that there is feedback at play in several other pairwise combinations: for example, the Old Masters market Granger-causes Contemporary Masters and Contemporary Masters Granger-causes the Old Masters.

TABLE 4. *Short-run causality tests by ECM for art and equity markets, 1976-2001*

	CM	FI	ME	NE	OM	SR	TE	US	EI	Causes
CM	—	1.1231 (0.3486)	1.7660 (0.1203)	1.0768 (0.3737)	2.3603 (0.0407)	1.1844 (0.3172)	2.0126 (0.0774)	1.6960 (0.1360)	1.4383 (0.2110)	1
FI	1.3291 (0.2523)	—	0.5409 (0.7452)	1.6871 (0.1382)	1.0072 (0.4140)	0.7218 (0.6076)	1.1846 (0.3172)	5.4898 (0.0001)	3.8121 (0.0024)	2
ME	3.0808 (0.0102)	4.2381 (0.0010)	—	1.7566 (0.1223)	2.4512 (0.0343)	1.0725 (0.3761)	2.2845 (0.0469)	1.9958 (0.0798)	1.2331 (0.2940)	4
NE	4.6156 (0.0005)	8.4547 (0.0000)	5.7950 (0.0000)	—	1.3726 (0.2351)	2.3122 (0.0445)	1.7104 (0.1327)	1.1250 (0.3475)	2.3189 (0.0440)	5
OM	2.9187 (0.0140)	(0.7837 0.5623)	3.0013 (0.0119)	3.2939 (0.0067)	—	4.0715 (0.0014)	0.6881 (0.6329)	1.8513 (0.1035)	2.2509 (0.0499)	5

SR	2.5632 (0.0277)	(0.4763 0.7938)	1.6197 (0.1553)	1.2576 (0.2829)	1.2920 (0.2678)	—	0.5185 (0.7622)	0.7343 (0.5984)	6.6547 (0.0000)	2
TE	1.8181 (0.1097)	1.8047 (0.1124)	1.4202 (0.2174)	2.1622 (0.0588)	3.1239 (0.0094)	2.0145 (0.0771)	—	2.1148 (0.0642)	0.3933 (0.8532)	1
US	0.6984 (0.6251)	11.0730 (0.0000)	5.4894 (0.0001)	3.0378 (0.0111)	0.9750 (0.4336)	1.0625 (0.3817)	0.7313 (0.6006)	—	1.9902 (0.0806)	3
EI	1.5642 (0.1707)	1.7918 (0.1150)	2.4459 (0.0346)	3.4854 (0.0046)	3.1664 (0.0086)	1.3132 (0.2588)	2.5282 (0.0296)	2.4693 (0.0331)	—	5

Caused	4	3	4	3	4	2	2	2	4	28
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Notes: Granger causality tests are conducted by adjusting the long-term cointegrating relationship by the ECM. Figures in brackets are p-values. Tests indicate Granger causality by row to column and Granger caused by column to row. For example, Contemporary Masters (row) Granger-causes one art market (Old Masters) and is Granger-caused by four (Modern European, European Nineteenth Century, Old Masters and Surrealists) using a 5% critical value.

It is evident that the equity market is the most influential market in terms of Granger-causation in the short-run. Five markets are influenced by the global equity market; namely, Modern European, 19th Century European, Old Masters, 20th Century English and Modern US paintings. However, Contemporary Masters, French Impressionists and the Surrealists are unaffected by the global equity market in the short run, at least at the .05 level. Among the art markets the most significant (in terms of the number of significant causes) is the 19th Century European and Old Masters paintings. Both of these art markets significantly influence five other markets. Another relatively influential market is Modern European painting that Granger-causes four markets. The least influential art markets in terms of Granger-causality include Contemporary Masters and 20th Century English paintings. These results appear plausible in terms of quantifying the well-known interrelationships between alternative art markets and between the equity market and art markets.

Long-run causality tests by level-VAR for art and equity markets, 1976-2001

	CM	FI	ME	NE	OM	SR	TE	US	EI	Causes
CM	—	29.4186 (0.0034)	46.7627 (0.0000)	46.7779 (0.0000)	58.6541 (0.0000)	66.7693 (0.0000)	9.3312 (0.6744)	61.9109 (0.0000)	23.7095 (0.0223)	7
FI	14.6739 (0.2598)	—	20.8347 (0.0529)	44.0360 (0.0000)	20.9137 (0.0517)	18.5037 (0.1012)	12.2163 (0.4285)	96.3209 (0.0000)	20.7284 (0.0545)	2
ME	38.4130 (0.0001)	43.6902 (0.0000)	—	54.0052 (0.0000)	34.3326 (0.0006)	7.9780 (0.7869)	14.7625 (0.2547)	47.9736 (0.0000)	13.3999 (0.3407)	5
NE	60.1726 (0.0000)	55.3636 (0.0000)	53.7748 (0.0000)	—	32.6718 (0.0011)	45.5748 (0.0000)	20.6269 (0.0561)	47.6644 (0.0000)	32.8021 (0.0010)	7
OM	24.3637 (0.0181)	14.9585 (0.2437)	19.8596 (0.0698)	36.3916 (0.0003)	—	38.0209 (0.0002)	5.9912 (0.9165)	32.6648 (0.0011)	16.6198 (0.1645)	4
SR	46.8706 (0.0000)	17.4831 (0.1323)	19.1867 (0.0841)	20.9968 (0.0504)	43.2282 (0.0000)	—	16.5297 (0.1682)	37.3573 (0.0002)	35.8460 (0.0003)	4
TE	28.7351 (0.0043)	17.4921 (0.1320)	14.1261 (0.2927)	37.1426 (0.0002)	19.5714 (0.0756)	16.3734 (0.1747)	—	31.9333 (0.0014)	27.5306 (0.0065)	4
US	22.5489 (0.0318)	32.5945 (0.0011)	31.3874 (0.0017)	32.3687 (0.0012)	15.3725 (0.2217)	17.2368 (0.1409)	22.5184 (0.0321)	—	15.4039 (0.2201)	5
EI	26.3749 (0.0095)	20.6504 (0.0557)	25.8609 (0.0112)	48.3209 (0.0000)	37.2244 (0.0002)	41.6945 (0.0000)	22.1980 (0.0354)	35.3859 (0.0004)	—	7
Caused	7	4	4	7	5	4	2	8	4	45

Notes: Unbracketed figures in table are Wald statistics for Granger non-causality tests. Figures in brackets are p -values. The level VARs are estimated with lag order of $p = k + d_{max}$; k is selected by the LR test in (5) and d_{max} is set to one. Tests indicate Granger causality by row to column and Granger caused by column to row. For example Contemporary Masters (CM) Granger causes all art markets with the exception of 20th Century English (TE) and is Granger-caused by all art markets with the exception of French Impressionists (FI).

One plausible implication of the results in Table 4 is that there may be no gains from pairwise portfolio diversification between those markets where a significant causal relationship exists. Also, since we have a finding of causality these markets must be seen as violating weak-form efficiency since one of the markets can help forecast the other. In all other cases, the absence of Granger causality implies that there are sufficient short-run differences between the markets for investors to gain by portfolio diversification. However, these results should consider that Granger causality only indicates the most significant direct causal relationship. For example, it may be that markets such as Contemporary Masters, which has only one significant causal link (with 20th Century English), may influence non-Granger caused markets indirectly through other markets. Likewise, some of the short-run interrelationships shown are likely to arise not from direct relationships between art markets and art and equity markets, rather through the influence of markets that have not been included in the analysis. For example, an equity index has been used in this study as a financial market relevant to investment in art markets. It may well be that the global property or bond markets, amongst others, are far more important in this respect, and in turn influence both art markets and the equity market. Equally likely are the various leading indicators of economic activity.

The long-run causality Wald test statistics and p -values based on Toda and Yamamoto's (1995) level VAR procedure are presented in Table 5. The model is estimated for the levels, such that a significant Wald test statistic indicates a long-term relationship. This serves to supplement the findings obtained from the Granger causality (short run) results in Table 4. Among the nine markets, forty-five significant causal links are found (at the 5 percent level or lower). This suggests immediately that there are many more significant causal links among art markets and between art and equity markets in the long run than in the short run. For example, column 5 shows that the Contemporary Masters, Modern European, 19th Century European, Surrealists painting markets and the global equity market affect the Old Masters market. This contrasts to the short run where the Surrealists market was not influential, though the 20th European painting market was. The rows in Table 5 indicate the effects of a particular market on all markets. It is evident that the 19th Century European market is again one of the most influential markets among the art markets, influencing all art markets except 20th Century English. However, the Contemporary Masters painting market, which was one of the least influential markets in the short run, causes just as many art markets as the 19th Century European market. The least influential market in the long run is French Impressionist paintings. Once again, the global equity market is highly influential, causing seven art markets with the exception of the French Impressionists. The finding of significant short and long run relations between equity and art markets contrasts strongly with the results of Ginsburgh and Jeanfils (1995). In that study, it was found that though financial markets did influence art markets in the short run, "...there is no long relation between these two assets" (Ginsburgh and Jeanfils, 1995: 538).

Generalised variance decomposition for the painting and equity markets, 1976-2001

MKT	PER	CM	FI	ME	NE	OM	SR	TE	US	EI	OTH
CM	1	85.4393	0.6254	1.5824	5.1951	0.0639	4.0762	0.0000	0.6395	2.3779	12.1827
	3	74.4839	0.4272	1.1268	12.3650	3.6831	2.7499	1.2882	1.7341	2.1412	23.3748
	6	63.5276	0.7304	1.8010	13.8983	10.5146	2.9714	1.5263	1.9532	3.0769	33.3954
	12	49.4975	2.8334	3.8752	19.8930	12.8114	2.6447	1.6836	3.5158	3.2452	47.2572
	AVG	68.2371	1.1541	2.0963	12.8380	6.7682	3.1106	1.1245	1.9607	2.7103	29.0525
FI	1	0.0000	60.4956	29.7923	7.2018	1.6258	0.0000	0.0000	0.4531	0.4313	39.5044
	3	0.0782	57.6493	21.6226	12.0686	1.1989	0.1548	0.7265	4.4070	2.0940	42.3507
	6	0.1596	45.0947	16.0130	19.6644	1.4301	0.2340	2.2124	13.0096	2.1820	54.9052
	12	0.8445	31.5792	10.4102	29.8261	6.2413	0.2458	1.9310	15.5601	3.3616	68.4207
	AVG	0.2706	48.7047	19.4595	17.1902	2.6241	0.1586	1.2175	8.3574	2.0172	51.2952
ME	1	0.0000	0.0000	96.0180	1.8310	2.0408	0.0000	0.0000	0.0000	0.1101	3.8718
	3	0.7494	0.3261	79.8583	8.4027	2.3226	0.0951	0.4110	5.3869	2.4477	17.6939
	6	0.9664	0.4250	70.4063	10.8735	5.3890	0.7957	0.7609	5.5884	4.7947	24.7989
	12	1.3624	2.8527	50.0013	22.0143	10.3680	1.1011	0.8250	6.3280	5.1471	44.8516
	AVG	0.7695	0.9009	74.0710	10.7804	5.0301	0.4980	0.4992	4.3258	3.1249	22.8040
NE	1	0.0000	0.0000	0.0000	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	3	0.6495	1.8253	1.5558	90.0740	0.7773	1.2037	0.0201	0.6596	3.2345	6.6914
	6	0.8992	1.4321	2.3795	75.7457	6.1583	1.2727	3.3092	4.0717	4.7313	19.5229
	12	1.8904	2.4388	1.7568	62.0904	12.0368	1.7279	4.0048	7.0683	6.9857	30.9238
	AVG	0.8598	1.4240	1.4230	81.9775	4.7431	1.0511	1.8335	2.9499	3.7379	14.2845
OM	1	0.0000	0.0000	0.0000	0.0359	99.9641	0.0000	0.0000	0.0000	0.0000	0.0359
	3	0.4081	1.3153	2.0741	0.2305	91.5195	0.5777	3.3901	0.2305	0.2540	8.2264
	6	1.9675	2.1339	2.0101	0.6890	80.5745	1.5564	4.5109	0.9519	5.6057	13.8197
	12	2.8195	2.0449	2.1535	3.3567	70.9074	3.6585	5.5120	1.5393	8.0081	21.0845
	AVG	1.2988	1.3735	1.5594	1.0781	85.7414	1.4481	3.3532	0.6804	3.4670	10.7916
SR	1	0.0000	2.9680	3.9098	0.0022	0.5369	90.4765	0.0000	0.8184	1.2882	8.2353
	3	0.0326	3.1912	4.4370	2.6570	1.5530	82.7571	1.6909	1.8189	1.8621	15.3808
	6	0.1362	3.1877	6.0997	4.1026	5.1847	74.3641	2.1442	2.5341	2.2466	23.3893
	12	0.2430	2.8859	5.6235	12.3039	13.0664	54.6669	3.5307	2.3081	5.3719	39.9611
	AVG	0.1029	3.0582	5.0174	4.7664	5.0852	75.5662	1.8415	1.8699	2.6922	21.7416
TE	1	1.3843	0.0019	1.0636	5.5053	0.3488	0.2259	88.4671	0.4888	2.5141	9.0187
	3	2.5932	0.3128	1.8008	6.2269	0.5904	0.6394	82.5397	0.4580	4.8386	12.6216
	6	6.7733	1.0751	3.1851	5.8140	2.1141	0.8078	70.5911	0.8282	8.8111	20.5978
	12	8.3852	1.4675	4.9261	5.2599	4.5647	0.8459	63.4011	0.8308	10.3187	26.2801
	AVG	4.7840	0.7143	2.7439	5.7015	1.9045	0.6298	76.2498	0.6514	6.6206	17.1296
US	1	0.0000	0.0000	4.8261	1.0304	3.5126	0.0000	0.0000	90.6287	0.0023	9.3690
	3	0.3943	0.8551	3.4202	0.7738	2.5216	1.0082	0.8768	89.8206	0.3293	9.8501
	6	1.3418	4.5225	3.5232	3.7749	3.1547	0.9120	4.5077	76.7242	1.5389	21.7360
	12	5.6936	7.2777	3.8411	8.3928	3.6055	1.4638	5.0162	62.4239	2.2853	35.2908
	AVG	1.8574	3.1638	3.9026	3.4930	3.1986	0.8460	2.6002	79.8993	1.0389	19.0617
EI	1	0.0000	0.0000	0.0000	0.3109	0.3644	0.0000	0.0000	0.0000	99.3247	0.6753
	3	1.2856	0.6672	1.6137	0.3970	2.0325	7.9600	0.3604	0.7668	84.9168	15.0831
	6	1.6468	3.9128	3.8759	2.0357	3.2632	7.9338	0.7930	1.8749	74.6638	25.3361
	12	1.6343	3.9844	4.2678	2.0448	3.4742	7.9151	1.1251	2.0828	73.4713	26.5286
	AVG	1.1417	2.1411	2.4393	1.1971	2.2836	5.9522	0.5696	1.1811	83.0942	16.9058
ALL	1-12	8.8135	6.9594	12.5236	15.4469	13.0421	9.9178	9.9210	11.3196	12.0559	22.5629

Notes: The final column (OTH) is the percentage of forecast error variance of the market indicated in the first column (MKT) explained by all art markets except the market's own innovations; the periods (PER) in the second column are in months. The ordering for the variance decomposition is based on the number of 'causes' in Table IV, i.e. NE, OM, EI, ME, US, FI, SR, CM and TE. 'AVG' is the arithmetic mean of the 1-month, 3-month, 6-month and 12-month horizons. 'ALL' in the final row is the average forecast error variance explained by the market in the first row across all markets and forecast horizons.

Table 6 presents the decomposition of the forecast error variance for 1-month, 3-month, 6-month and 12-month ahead horizons for the equity markets and the art markets. An average forecast error variance across these horizons is also included in Table 6 for each market

(AVG), while the final column in Table 6 (OTH) sums the percentage of forecast error variance of each market explained by all other art markets other than the market itself. The final row in Table 6 (ALL) averages the percentage of forecast variance for each market across itself and all other markets in all forecast time periods. Each row in Table 6 indicates the percentage of forecast error variance explained by the column heading for the market indicated in the first column. For example, at the 1-month horizon, the variance in the 19th Century European market is completely explained by its own innovations (100.00), whereas in the remaining markets some percentage of variance is explained by innovations in other markets. For example, in the Contemporary Masters market 85.43 percent of variance is explained by its own innovation, while in the 20th Century English painting market 88.47 percent is explained by variations in itself. At the 1-month horizon, other painting markets explain 12.18 percent of variance in the Contemporary Masters market, 39.50 for French Impressionists, 3.87 for Modern European, 0.03 for Old Masters, 8.23 for the Surrealists, 9.01 for 20th Century English, and 9.37 for Modern US paintings. These would indicate that the 19th Century European painting market is the least influenced by innovation in other painting markets in the 1-month forecast period, while the French Impressionist market is the most sensitive.

Nonetheless, all the painting markets included in the analysis are relatively isolated from each other at the 1-month horizon period. This is consistent with the extreme lack of liquidity and the slow diffusion of information in art markets. However, within a 3-month forecast horizon period most of the variance that will ever be explained in any painting market, whether through its own innovations or through other painting market innovations, has occurred. This suggests that there are lags in the transmission of information among art markets, though they are certainly less than what could normally be expected. Once again, the most influential painting market is 19th Century European paintings with some 15.44 percent of forecast error variance across all markets and forecast horizons. The next most influential painting markets in terms of forecast error variance are Old Masters (13.04%) and Modern European (12.52%). The least influential markets are composed of Contemporary Masters (8.81%) and French Impressionists (6.95%).

Just as the painting markets are relatively isolated from each other, they are also relatively isolated from the equity market. For example, at the 1-month horizon period no forecast error variance in the 19th Century European and Old Masters painting markets and just 2.51 percent in the 20th Century English painting market, are explained by innovations in the equity markets. Though this steadily increases as the forecast error horizon is extended, even at the end of one year the percentage accounted for in these three markets by the equity market is just 6.98, 8.00 and 10.31 percent respectively. On average, and across time horizons, the market that has the most forecast error variance explained by the equity market is the 20th Century English painting market with 6.62 percent, while the least forecast error variance is explained in the Modern US painting market.

5. Concluding Remarks

This paper investigates long-term and short-term relationships among eight major painting markets and the global equity market during the period 1976 to 2001. Multivariate cointegrating techniques are used to establish relationships among these markets; Granger non-causality tests within an error-correcting model (ECM) are used to measure causal relationships in the short-term, while Wald test statistics in a level VAR approach are used to measure long-run causality. The results indicate, as expected, that the art markets are highly

integrated and that there are a large number of significant causal linkages in both the short and long run among art markets and between the equity market and art markets.

The findings obtained in this paper have obvious implications, amongst other things, for the purported benefits of portfolio diversification among the several alternative painting markets. In effect, the strong short-term and long-term causal linkages among the markets would indicate that the expected returns from such a strategy may not be as great as expected. However, the results also suggest that opportunities for diversification may still exist. This is further reinforced by a decomposition of variance analysis that indicates that a distinguishing characteristic of most art markets is the extremely low level of variance explained by other markets, including the equity market. Even in the least isolated art markets, other painting markets explain no more than thirty percent of the forecast error variance across all horizon periods.

The sole exception in this case is the market for French Impressionist paintings, which is the least endogenous market examined in this study. Interestingly, the most isolated painting market is that of Old Masters. With the former most associated with the bear market in art in the early 1990s and the later with a resurgence in the final years of last century there is the suggestion that market segmentation has much to do with pricing behaviour in these markets. Unfortunately, it is not possible in this particular study to examine how these relationships have changed over time since no decomposition of the sample period is attempted.

In terms of the interrelationships between art and equity markets this study has quantified the significant short and long-run causal linkages that exist. Nonetheless, the percentage of forecast error variance explained in art markets by the equity market is extremely low. Chanel (1995: 527) has used similar findings to conclude: "It would appear, then, that financial markets react quickly to economic shocks, and that the profits generated on these markets may be invested in art, so that stock exchanges may be considered as advanced indicators to predict what happens on the art market". However, and in common with Chanel's (1995) conclusions, art markets are subject to varying fashions, tastes and fads, and thus the endogeneity of these markets makes forecasting extremely difficult.

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